Parenteral Nutrition Administration by Critical Care Nurses in Iran

A Performance Evaluation

Atefeh Taherkhani, MSc ● Akram Shahrokhi, MSc ● Ameneh Barikani, PhD ● Farnoosh Rashvand, PhD

ABSTRACT

In Iran, nurses are responsible for administering parenteral nutrition (PN) to hospitalized patients in intensive care units (ICUs). However, little information is available among nurses in Iran regarding best practices in PN administration. This study evaluates the performance of critical care nurses in Iran in the administration of PN. The performance of 50 nurses in the administration of PN in the ICU was observed 3 times during a 5-month period for a total of 150 observations. A researcher-developed checklist, "Critical Care Nurses' Performance in Parenteral Nutrition Administration," was used for data collection. The total score in this checklist ranged from 0 to 52. Based on the procedural steps in the checklist and whether the steps were performed appropriately, nurses' performance was scored as poor, moderate, or good. The mean score of nurses' performances in PN administration skills was 24.6 ± 2.5. This study found that 46 nurses had moderate skill levels in PN administration, and 3 demonstrated poor skills. Overall, the results indicated that critical care nurses in Iran have poor to moderate PN administration skills.

Key words: critical care, intensive care unit, nutrition, parenteral nutrition, peripheral parenteral nutrition, total parenteral nutrition

Profound metabolic changes occur in critical care patients admitted to intensive care units (ICUs) that increase their need for extra energy.[1] Meeting the nutritional needs of patients in the ICU is imperative because poor nutrition can negatively impact patient outcomes.[2,3] Malnutrition in critical care patients is associated with impaired immune function, muscle weakness, reduction of adipose tissue, increased mechanical ventilation-dependency, increased length of hospital stay, diminished quality of life, and increased mortality and morbidity.[1,4] In 2013, Shpata et al[5] studied malnutrition and its complications in ICU patients. Results of that study showed that nearly 64% of critical care patients had some degree of malnutrition. The results also showed that the rate of complications in malnourished patients is 3 times higher than in well-nourished patients.[5]

Oral feeding is not usually administered with critical care patients because of their clinical situation.[1] Therefore, a large proportion of these patients require artificial nutrition, given either as parenteral or enteral nutrition.[2] Enteral nutrition is a method of supplying nutrients through the gastrointestinal tract when the patient cannot ingest, chew, or swallow food. Parenteral nutrition (PN) is used when enteral nutrition is not feasible, or the patient is malnourished or at high nutrition risk.[6] Taking the principles of PN administration into consideration can significantly reduce the risk of complications, such as infection, changes in blood glucose levels, fluid and electrolyte disturbances, vein irritation, and catheter occlusion.[2]

Author Affiliations: *Qazvin University of Medical Sciences, Qazvin, Iran; student research committee (Ms Taherkhani); Social Determinants of Health Research Center and Department of Nursing, Faculty of Nursing and Midwifery (Ms Shahrokhi and Dr Rashvand); and Children Growth Research Center (Dr Barikani).*

Atefeh Taherkhani, MSc, *is a critical care nurse with more than 5 years' experience in several hospital wards and intensive care units.* **Akram Shahrokhi, MSc,** *has been a faculty member at the Qazvin School of Nursing and Midwifery for more than 25 years. She conducts several research projects each year and teaches critical care nursing subject matter.* **Ameneh Barikani, PhD,** *is an associate professor in community medicine at the Qazvin University of Medical Sciences. Dr Barikani specializes in research methodology and statistics.* **Farnoosh Rashvand, PhD,** *is an assistant professor at the Qazvin School of Nursing and Midwifery. She supervises theses, conducts research, and teaches in the field of critical care nursing. Dr Rashvand specializes in patient safety.*

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Corresponding Author: *Farnoosh Rashvand, PhD, Qazvin University of Medical Sciences, Department of Nursing, Faculty of Nursing and Midwifery, Shahid Bahonar Boulevard, Qazvin, Iran 3419759811 (rashvandifar1361@gmail.com; f.rashvand@qums.ac.ir).*

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In Iran, nursing staff play a key role in the administration of PN to adult patients in the ICU.[7,8] Yet few studies exist that examine the role of the infusion nurse in Iran, and so little information is available among Iranian nurses. Previous studies have focused on the role of physicians and nutritionists in meeting the nutritional needs of patients in the ICU.[3] In studies focusing on nursing staff, the emphasis is typically on evaluation of a nurse's knowledge and practice in administration of enteral nutrition to patients in the ICU—not on the nurse's performance of PN administration.[9-12] While the preferred option for nutritional support is the enteral route, nurses should be trained and educated to administer PN to patients appropriately and safely to prevent complications. This study was designed and conducted to evaluate the performance of Iranian critical care nurses in the administration of PN.

METHODS

Setting and Sampling

This descriptive-analytic study was conducted in 2018 at hospitals affiliated with Qazvin University of Medical Sciences. This university has 3 teaching hospitals, and each hospital contains 1 adult ICU. A total of 50 patients with PN needs were admitted to the ICU during the study period. The performance of 50 nurses in the administration skills of PN was observed 3 times for a total of 150 observations over a 5-month period. Nurses were aware that their performance was being recorded by the researchers during their work shift, yet they did not know exactly when they were being recorded. The inclusion criteria for the nurse participants were at least 1 year of clinical experience and a minimum of a bachelor's degree in nursing.

Instrument

A researcher-developed checklist, "Critical Care Nurses' Performance in Parenteral Nutrition Administration," was used for data collection. This checklist was designed based on scientific literature[1,2,13-17] and had 26 procedural steps with the following 3 scores: Not Completed (0 points); Incorrectly Completed (1 point); and Completed (2 points). Scoring was determined by 5 faculty members of Qazvin University of Medical Sciences who were experts in questionnaire development. The procedural steps were divided into 3 subgroups: performance before the procedure included steps 1 to 12; performance during the procedure included steps 13 to 23; and performance after the procedure included steps 24 to 26. The total score in this checklist ranged from 0 to 52. Based on the steps in the checklist and whether the procedure was performed correctly, nurses' performance was scored as poor (0-18), moderate (19-34), or good (35-52). A higher score reflected a better performance.

Validity and reliability of the checklist were determined by a number of criteria. It was originally designed as a 32-step procedure based on a literature review and the professional knowledge of head nurses, supervisors, and faculty members. Face validity was determined by interviewing a group of 10 head nurses, supervisors, and faculty members. The checklist was measured for difficulty level, proportionality, and ambiguity. The impact score method was used to determine the face validity. An impact score was calculated (impact score = frequency [%] × importance). Steps with a score of 1.5 or higher were retained. Two steps were omitted because of a score of less than 1.5. To determine the content validity, 10 experts with knowledge of instrument development, some nurses who participated in this study, and supervisors were asked to comment in writing on the clarity and simplicity of the steps. Content validity ratio (CVR) and content validity index (CVI) were used to quantitatively test the content validity. Modified Lawshe's CVR was used as a basis to determine the CVR. Using this method, the questionnaire was given to a panel of experts to evaluate each step. Based on the modified Lawshe's CVR, a score of 0.63 or higher was considered an essential step. Two steps with a score of less than 0.63 were omitted. To determine the CVI, the proportion of experts' agreement on the relevancy of the steps (the number of experts who gave scores of 3 and 4 [range of 1 to 4] to each theme/the total number of experts) was measured. Therefore, a CVI score of 0.78 was considered acceptable in this study according to suggestions from Polit et al.[18] Two steps with a score of less than 0.78 were omitted. The total CVI was calculated to be 0.87. To determine the reliability of the 26-step checklist, an open-test method was used. Intraclass correlation coefficient was calculated to be 0.91, which indicated a high level of reliability. Cronbach's alpha coefficient was used to determine the internal consistency of the checklist (0.76).

Ethical Considerations

This study was approved by the Ethics Committee of Qazvin University of Medical Sciences and received ethical permission (ethics code: IR.QUMS.RES.1396.205). Participation in this study was voluntary, and nurse participants were informed about the goals and the methods of the study. The researchers explained that participants' identities would not be disclosed and that the findings would only be used for the specified purposes of the approved proposal. To ensure confidentiality of the nurse participants, a numerical code was assigned to each participant.

Data Analysis

Data were collected using Statistical Package for the Social Sciences 16 (SPSS-16; IBM, Armonk, NY) and analyzed using descriptive statistics (mean and standard deviation for quantitative data, percentage and frequency for qualitative data) as well as inferential statistics (chi-square, independent *t* test, and variance analysis). The confidence level was 95%, and the significance level was $\alpha > 0.05$.

RESULTS

Of the 50 nurses who agreed to participate, 1 did not complete the administration procedures and was excluded.

Forty-nine nurses participated in the study, consisting of 42 females and 7 males. The mean age of the nurses was 31.4 years, with a standard deviation of 4.5 years. Forty-five nurses had a bachelor's degree in nursing, and 4 nurses had a master's degree in nursing. The mean number of years of working experience was 6.1. Fifty percent of the nurses had a working experience of 5 to 10 years.

Total parenteral nutrition (TPN) was administered to 38 patients, and peripheral parenteral nutrition (PPN) was administered to 11 patients. The mean score of nurses' PN administration skills was 24.6 ± 2.5. Based on checklist scores, 46 nurses scored moderate and 3 nurses scored poor. The best and poorest performance status was before and during the PN procedure, respectively. Tables 1 to 3 detail how participants responded to the steps on the checklist. The mean score of nurses' performance in TPN administration was 24.8 ± 2.6 and in PPN was 23.9 ± 2.9. This difference was not statistically significant ($P < .05$). The mean score of performance among female and male nurses was 24.9 and 22.8, respectively. Based on the results of an independent *t* test, this difference was statistically significant ($P = .046$). The mean score of performance among nurses with bachelor's degrees and nurses with master's degrees was 24.5 and 26, respectively. Based on the results of an independent *t* test, this difference was not statistically significant ($P = .269$). Nurses' work experience was divided into 3 categories: 1 to 5 years, 5.1 to 10 years, and more than 10 years. The mean score of performance were similar in 3 groups. The results of a 1-way ANOVA analysis showed no significant difference in the mean score of nurses with different years of working experience. However, the mean score of nurses with working experience of less than 5 years was slightly lower compared with nurses who had 5.1 to 10 years or more than 10 years' experience ($P = .104$).

DISCUSSION

Based on the tasks on the checklist, the study results showed that nurses have poor to moderate PN administration skills. Nurses demonstrated the best performance *before* the PN procedure, and the poorest performance *during* the PN procedure. Female nurses performed better than male nurses based on the gender demographics collected. This could be related to 2 factors. First, all 4 master's-prepared nurses in the study were female and obtained higher scores compared with bachelor's-prepared

TABLE 1

Critical Care Nurses' Performance in Parenteral Nutrition Administration

Steps Before the Procedure	Not Completed	Incorrectly Completed	Completed	Mean Score
1. The nurse verifies the physician's order with the label on the nutrition solution container.	2%	63.3%	37.7%	1.32 ± 0.51
2. The nurse places the prescribed solution at room temperature for 1 hour before the procedure.	6.1%	14.3%	79.6%	1.73 ± 0.56
3. The nurse assesses the quality of the solution (eg, type of solution, expiration date, turbidity, or presence of suspended particles, brown layer in lipid solutions).	6.1%	10.2%	83.7%	1.77 ± 0.57
4. The nurse returns the solution to the pharmacy if there is a quality defect (eg, turbidity, or the presence of suspended particles, brown layer in lipid solutions).	10.2%	69.4%	20.4%	1.10 ± 0.54
5. The nurse documents necessary explanations; infusion start date and time, type and volume of solution, injection rate or number of droplets on the parenteral nutrition label.	20.4%	14.3%	65.3%	1.45 ± 0.82
6. The nurse verifies the patient's name.	77.6%	2%	20.4%	0.42 ± 0.53
7. If the patient is alert, the nurse explains the steps involved in the procedure.	89.8%	8.2%	2%	0.12 ± 0.32
8. The nurse washes his or her hands in accordance with hospital policy.	65.3%	18.4%	16.3%	0.51 ± 0.76
9. The nurse assesses and notes the type of vascular access device to be used (eg, peripheral or central catheter).	8.2%	77.6%	14.3%	1.06 ± 0.47
10. The nurse establishes an appropriate vascular access device if the patient does not have one.	0%	55.1%	44.9%	1.44 ± 0.50
11. The nurse assembles the necessary supplies for parenteral nutrition.	4.1%	75.5%	20.4%	1.16 ± 0.47
12. The nurse wears sterile gloves.	46.9%	18.4%	34.7%	0.87 ± 0.90

TABLE 2

Critical Care Nurses' Performance in Parenteral Nutrition Administration

Steps During the Procedure	Not Completed	Incorrectly Completed	Completed	Mean score
13. The nurse maintains sterile technique when securing tubing connections.	16.3%	26.5%	57.1%	1.40 ± 0.76
14. The nurse adjusts the infusion rate based on the physician's prescription and starts the infusion.	81.6%	6.1%	12.2%	0.30 ± 0.58
15. The nurse administers dextrose (up to 10%) solution based on the rate of the physician's prescription in order to prevent glucose fluctuations.	100%	0%	0%	0
16. To monitor the flow rate, the nurse checks the settings of the infusion pump every 30 minutes (or less if necessary).	87.7%	6.1%	6.1%	0.18 ± 0.53
17. After the solution is completed, the nurse prepares the new solution while maintaining a sterile technique.	0%	98%	2%	1.02 ± 0.14
18. The nurse replaces the administration set and filters every 24 hours and for intralipid infusion immediately after the infusion.	0%	98%	2%	1.02 ± 0.14
19. The nurse assesses the CVAD insertion site and replaces the dressing every 24 hours. The dressing is replaced sooner if the site is wet or dirty.	0%	6.1%	93.9%	0.93 ± 0.24
20. The nurse assesses the skin around the insertion site for redness, warmth, and pain (signs of phlebitis) during the infusion.	0%	91.8%	8.2%	0.16 ± 0.55
21. The nurse monitors and documents the patient's vital signs according to the physician's order.	0%	73.5%	26.5%	0.53 ± 0.89
22. The nurse assesses the patient for signs of hypoglycemia based on the patient symptoms (eg, sweating, dizziness, nausea, etc.).	4.1%	22.4%	73.5%	1.69 ± 0.54
23. During the infusion, the nurse monitors the patient's intake and output every hour.	4.1%	71.4%	24.5%	1.20 ± 0.49

Abbreviation: CVAD, central vascular access device.

nurses of either gender. Work experience was also a factor; male nurses had fewer years of experience compared with female nurses. Nurses who have more work experience performed better in this study. It should also be noted that only 7 male nurses participated.

Although this study revealed that the poorest performance was *during* PN administration, deficiencies were noted in other procedural steps of PN administration. These steps included applying aseptic technique, ensuring that connections were secure, and adjusting and monitoring infusion rates. The literature search showed 2 studies that related to the nurses' performance in PN. Mohammed and Taha's[13] 2014 study in Egypt evaluated the PN administration knowledge and performance of 80 ICU nurses. To evaluate the nurses' performance, they used a checklist compiled by 28 researchers. This checklist evaluated the nurses' performance in preparation, administration of the solution, and management of complications. They observed

TABLE 3

Critical Care Nurses' Performance in Parenteral Nutrition Administration

Steps After the Procedure	Not Completed	Incorrectly Completed	Completed	Mean score
24. After the infusion is completed, the nurse aseptically removes the administration sets.	75.5%	2%	22.4%	0.46 ± 0.84
25. The nurse disposes used equipment based on hospital policy.	2%	95.9%	2%	1.00 ± 0.20
26. The nurse accurately documents the procedure, including the infusion starting date and time, the patient's reactions during the infusion, and any medical and nursing interventions.	0%	14.3%	85.7%	1.71 ± 0.70

nurses' performance before, during, and after PN administration 3 times. The results of their study showed that nurses did not demonstrate acceptable performance in PN administration, with the poorest performance noted *during* the PN procedure.[13] Another study, by Rupawaththa et al[14] in Sri Lanka, evaluated the nurses' performance using a self-report questionnaire. They did not discuss the details of their methodology. Unlike the results of this study, the results of Rupawaththa and colleagues' study showed that nurses demonstrated relatively good performance when administering PN. These differences may be due to methodology and method of data collection. In this study, the observational method was used to evaluate the nurses' performance of PN administration, while in Rupawaththa and colleagues' study, data were collected using self-report questionnaires.

The nurses' poor PN administration performance can be attributed to several factors. First is the limited training in Iran's nursing education system. For example, nurses with bachelor's degrees are permitted to work in an ICU. However, they only receive a 2-week internship in the ICU during their schooling. This limits their education, especially in the area of PN administration. However, during the past decade, Iran's Ministry of Health and Medical Education has launched a postgraduate nursing care program that includes critical care nursing concepts. Nurses can enroll after earning their bachelor's degree and completing 2 years of clinical employment. The 4 participants in this study who had master's degrees had a higher mean performance score than participants with only bachelor's degrees. These findings suggest that obtaining a master's degree in nursing can have a positive impact on nurses' PN administration skills.

Another factor for poor performance is the lack of implementation of standardized nutrition guidelines for patients in the ICU. In Iran, the physicians order the nutritional therapies, while nurses both administer the nutrition and monitor the patients. Lack of resources and, in some cases, inadequate management of resources in health care also contribute to poor performance. In addition, nursing shortages in Iran have resulted in inexperienced nurses working in ICUs.

LIMITATIONS

One limitation was the use of the observation method for data collection. Although nurses did not know exactly what part of their performance was recorded, observation can impact behavior. The possibility of observer errors should also be considered.

CONCLUSION

Nurses play a significant role in PN administration and must perform the procedure according to international standards. Poor performance significantly affects patient outcomes. In this study, the Iranian critical care nurses demonstrated poor to moderate PN administration skills that may be related to limited awareness of these international standards. Results of this study are useful for nurse educators to develop educational and training programs.

In addition to short-term measures, health care systems should take initial steps toward long-term improvements. These steps include improving undergraduate nursing curricula, developing the field of critical care nursing, and using a standardized PN administration protocol for patients in the ICU. Given the lack of studies—especially among nurses in developing countries such as Iran—similar studies are strongly recommended. The authors also recommend a follow-up study to examine the impact of education on nurses' PN administration skills.

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